Spectrometer for Materials Research at Temperature and Stress (SMARTS)

SMARTS is a third-generation neutron diffractometer optimized for the study of engineering materials. It was funded by DOE and constructed at the Lujan Center at Los Alamos, entering commissioning in the summer of 2001. It provides an exciting range of capabilities for studying polycrystalline materials focusing on two areas: the measurement of deformation under stress and extreme temperature and the measurement of spatially resolved strain-fields. The underpinning technique is neutron diffraction, which has been used to study engineering structural materials since the early 1980s.

SMARTS expands the application base of neutron diffraction to a wider range of engineering problems than currently possible. With an extensive array of *in situ* capabilities for sample environments, it enables measurements on small (1 mm^3) or large (1 m^3) samples. Components with dimensions up to 1 m and up to 1500 kg can be positioned precisely in the beam. Permanently mounted alignment theodolites provide a simple and efficient way to position samples or equipment to within 0.01 mm.

The furnace and load frame suite allows research on materials under extreme loads (250 KN) and at extreme temperatures (1500°C). *In situ* uniaxial loading on samples up to 1 cm in diameter at stresses of 2 GPa and with lower stresses at temperatures up to 1500°C are routine.

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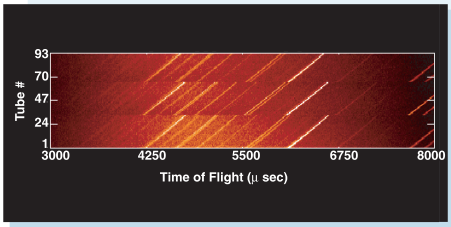
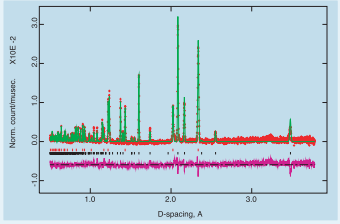


Raw data for sodium cyanate, Na(OCN), recorded as a precursor to high-pressure measurements to 10 Kbar where the material is expected to undergo a rhombohedral to monoclinic transformation.
(Collaboration between LANSCE and Christian-Albrechts-University; courtesy Sven Vogel, LANL)

Diffraction pattern and Rietveld refinement for Al-Al_2O_3 composite
(courtesy Jay Hanan, Caltech)



"Short" radial collimator supported between load frame and detector

SMARTS Specifications

Performance	
Moderator	Chilled H_2O, high resolution
Resolution at 90° (wavelength dependent)	~ 0.4%
d-spacing range	~ 0.5-4 Å
Nominal time for 1 cm^3 under load at temperature	~ 10 minutes
Nominal time for 1 mm^3 in 10-mm-thick Fe plate	~ 60 minutes
Primary Flight Path	
Moderator to sample	~ 31.0 m
Incident collimation (at sample)	1-625 mm^2
Secondary Flight Path	
Sample to 90° tube	~ 1.5 m
2q angle subtended (each 90° bank)	~ 30°
Load Frame-Furnace	
Maximum uniaxial force (compression or tension)	250 KN
Actuator motion	0.15 m
Furnace maximum temperature - under load	1500°C
Furnace maximum temperature - stand alone	1800°C
Specimen geometries	Threaded tensile/Cylinder compression
Translator	
Capacity	1500 kg
Motions	X = 0.3 m,Y = 0.3 m, Z = 0.6 m, R = 370°
Radial Collimators	
2q angle subtended	20°
Spatial resolution parallel to beam	1, 2, 3, 4, 5 mm